CHAPTER 7

PHOTOGRAPHY

Overview

Introduction

You may think all you need to know as an Illustrator Draftsman is how to illustrate. However, you must also have a rudimentary knowledge of photographic principles (exposure, development, and printing) and film types. Your knowledge may save many hours of labor for you or for the Photographer's Mates or Lithographer's Mates in support shops. Obtain copies of the *Photography (Basic),* NAVEDTRA 12700, and *Lithographer's Mate*, NAVEDTRA 10451, training manuals. For further study in photography, review the work of Ansel Adams, Edward Weston, Berenice Abbott, and Julia Margaret Cameron.

Objectives

The material in this chapter enables you to do the following:

- State the procedures for positioning unexposed film or paper in process cameras.
- Define digital photography.
- Relate exposure time to f/stop settings.
- Identify film types and match them to specific purposes.
- Distinguish between reversals and negatives.
- Recognize film types used to photographically reproduce line art and continuous-tone art.
- Describe the effect enlarging or reducing photographs has on resolution and grain.
- Distinguish between cropping photographs and scaling photographs.
- State the purpose and procedures for indicating crop marks on photographs.

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Acronyms

The following table contains a list of acronyms that you must know to understand the material in this chapter.

Acronym	Meaning
CCD	Charged Coupling Device
CD	Compact Disks
IR	Infrared Light
ISO	International Standards Association
mm	Millimeter
PMS	Planned Maintenance System
pixel	Picture Element
RC	Resin Coated
RH	Relative Humidity
SLR	Single-Lens Reflex
TTL	Through the Lens Metering
UV	Ultraviolet Light

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Overview, Continued

In this chapter This chapter covers the following topics:

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Cameras

Introduction

You may have to operate cameras in the shop or small-format adjustable cameras in the field. Knowledge of camera types and basic functions of camera parts is essential. The theory of operation and maintenance procedures for different camera types is similar.

Camera theory

Cameras are mechanical optical instruments that use light to record latent images on film or paper. Light, reflected from object surfaces or scenes, enters the camera through a lens. Lenses funnel light through a series of convex and concave, optically pure glass until the light reaches the film surface. Controlling the amount of light and the length of exposure to light determines how films register light until chemicals develop the image on the film.

Camera maintenance

All cameras require maintenance. To keep cameras in your shop in optimum working condition, you should perform regular camera maintenance. The Navy Planned Maintenance System (PMS) has PMS cards detailing maintenance procedures and periodicities. Maintenance on process, copy, and small-format cameras may consist of any of the following actions.

Inspect all electrical cords for fraying or bare wire.

- Check the battery compartment for battery status:
  - is the battery present,
  - is the battery fresh, and
  - is the battery swollen or leaking.
- Clean optical surfaces with lint-free cloths or chamois.
- Clean mirrored surfaces with soft camel hair brushes.
- Remove debris and lint from bellows, copyboard, and film plane.
- Lightly oil rotating handwheels, cranks, and worm gears.
- Wipe down camera body with lint-free cloths or chamois.
- Dust inside film back with soft camel hair brushes.
- Remove batteries before storing the camera for any length of time.

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Camera planes

Cameras consist of three parallel planes: the copy plane, the lens plane, and the focal plane.

COPY PLANE: The copy plane is where the copy, object, or scene exists. For small hand-held cameras, it is the scene or object. For copy or process cameras, it is a glass copyboard that holds the original copy in place. The most common size copyboard is 18 by 24 inches, with gridded reference lines to help align the original copy. A vacuum creates suction to pressure flatten copy placed on the copyboard. On process and copy cameras, the copy plane may move on tracks for proportional reductions or enlargements.

LENS PLANE: The lens plane is where the lens is located. On small adjustable cameras and some process and copy cameras, the lenses are interchangeable. On copy and process cameras, the lens plane moves on tracks for proportional reductions or enlargements.

FILM or FOCAL PLANE: The film plane holds the film in place in the back of the camera. The film plane is sometimes called the focal plane because the image focuses on ground glass or mirrors located at the focal plane before exposure. On process or copy cameras, the film plane may also have a filter attachment for halftone or color separation work.

Figure 7-1 shows the different parallel planes of a camera.

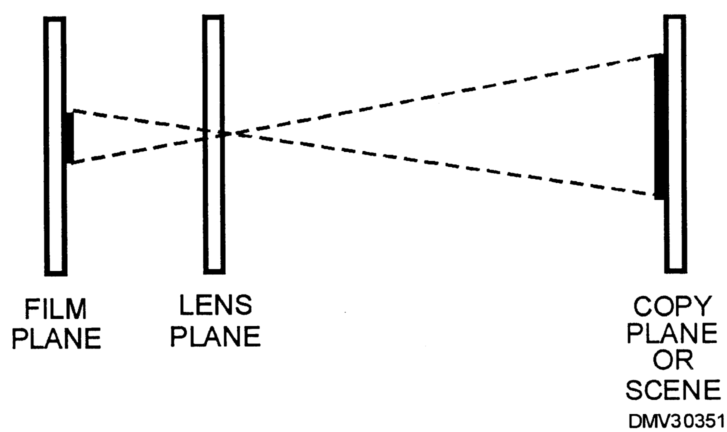

Figure 7-1.—The three parallel planes of a camera.

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Camera adjustments

Each of the three parallel planes of a camera has further adjustments to control the size, sharpness, brightness, and contrast of images. Scales control ‘image size. Focus and aperture rings, along with shutter speed and film speed dials, control image resolution.

SCALES: Scales on process and copy cameras control percentages of reduction or enlargement. Most of these cameras reduce to 50% and enlarge to 300%, or any range in between. Scales are usually located on the head of process and copy cameras.

FOCUSING CONTROL: Except for cheaply made cameras, most cameras can focus or adjust the sharpness of images striking the film or focal plane. Images on the ground glass of copy or process cameras appear fuzzy until you rotate the handwheels or cranks of the three planes. You may need a loup or magnifier to focus sharply. On small adjustable cameras, the image appears in the viewfinder as a ghost or double image, or as broken images that you align into one image. To align images, rotate a sleeve on the lens until the two images appear superimposed (directly on top of the other). Specialty focusing screens, such as hairlines and grids, are available to accommodate individual preferences.

Figure 7-2 illustrates the most common focusing screen images.

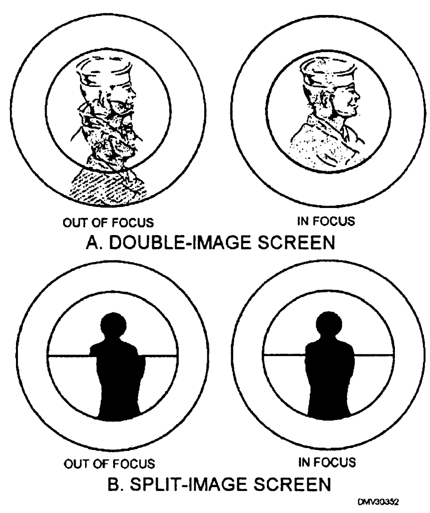

Figure 7-2.—Common focusing screens: A. Double-image; B. Split-image.

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Camera adjustments (Continued)

BELLOWS: Bellows are accordion-folded segments between the lens and the film plane of most process and copy cameras. Bellows maintain light-tight integrity during enlargements and reductions. The use of bellows on small adjustable cameras is limited to macro (close up) or copy work.

EXPOSURE CONTROLS: Exposure controls involve shutter speed dials and aperture rings. Once the copy plane, lens plane, and film plane are correctly positioned, select the settings for exposing film to the light. The length of exposure is called *shutter speed*. The amount of exposure is called *aperture*. Automated cameras may set shutter speed, aperture, or both for you. Cameras that require you to select the aperture and automatically set the corresponding shutter speed are called *aperture priority*. Cameras that automatically select apertures based on your shutter speed-selection are called *shutter priority*. The shutter speed dial is located on the head of the camera. The aperture ring is a collar around the lens. Most cameras allow manual manipulation or override of the automatic mode.

FILM SPEED: Film speed indicates how sensitive or receptive film is to light. Every film type has a rated speed set by the International Standards Organization (ISO). The film speed is referred to as *ISO*. Set the camera film speed dial to reflect the ISO of the film. Generally, the lower the ISO rating, the slower the film records light. A slow film requires more light and either longer shutter speeds or larger aperture openings to acheive proper film exposure. Slow film has a less grainy appearance in print, which results in increased resolution or sharpness in enlargements.

Process and Copy Cameras

Introduction

Some Navy graphics shops and most Navy print shops use process or copy cameras. You should understand the limitations and capabilities of these cameras before you begin creating art intended for photographic reduction or enlargements.

Process cameras

Process cameras are large studio-type cameras that use sheet film or paper. These cameras may be horizontal or vertical in construction. Horizontal process cameras are either darkroom cameras or gallery cameras. Darkroom cameras have the film plane built into a wall. The other side of the wall is in the darkroom. Darkroom cameras are loaded with film from the darkroom. Repositioning copy requires you to exit the darkroom and enter the part of the shop or studio that houses the forward part of the camera. Gallery cameras are free-standing horizontal units. Vertical process cameras take up less space. Both horizontal and vertical process cameras are available with fully automated exposure control. Some of the newer process cameras automatically develop the film or paper after exposure.

Figure 7-3 shows examples of the two types of process cameras.

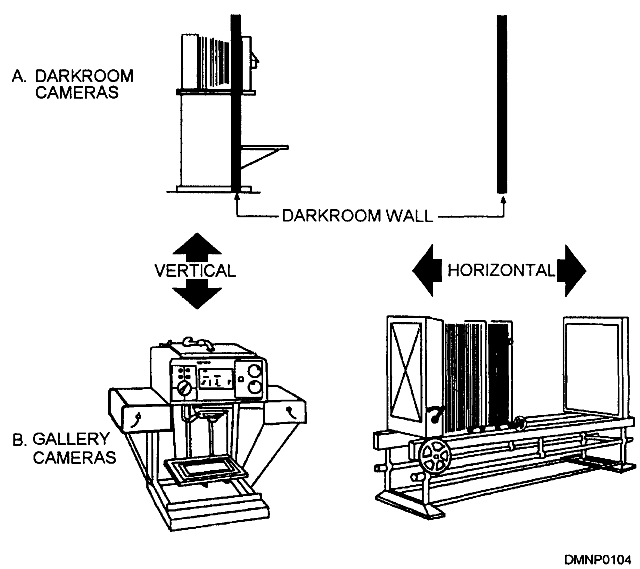

Figure 7-3.—Process cameras: A. Darkroom cameras; B. Gallery cameras.

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Process camera major components and adjustments

The major components of a process cameras are a copy plane, a film plane, and a lens plane. Adjustments include scales (the ratio of reduction or enlargement), shutter speed (timer), and aperture. Copy or process cameras may also have an optional built-in lighting system.

Figure 7-4 shows a basic process camera with the major components and adjustments identified.

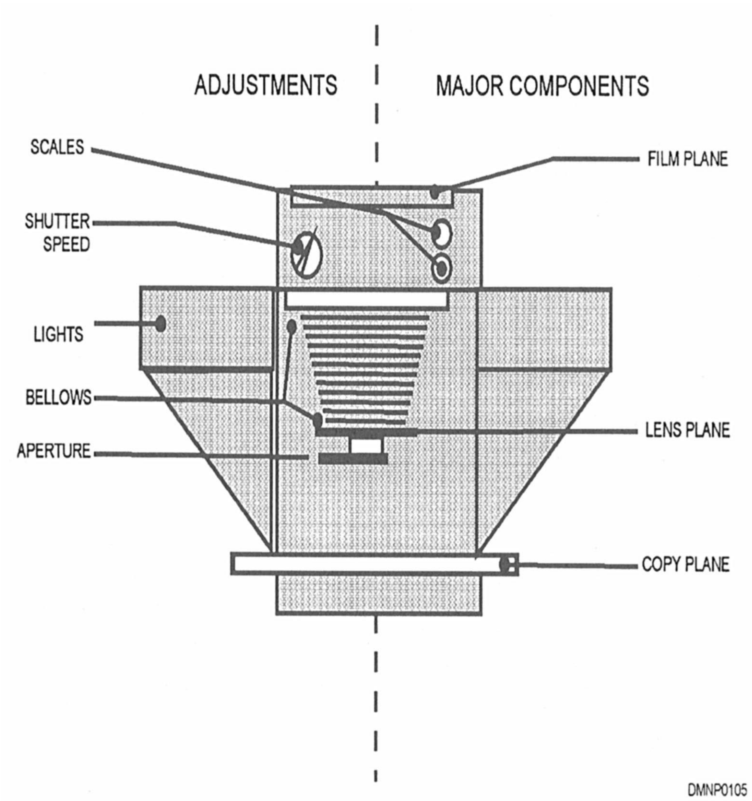

Figure 7-4.—Process camera nomenclature.

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Using a process camera

Using a process camera can be frustrating if you approach the task without regard for accuracy.

To use a process camera:

Step	Action
1	Visually inspect the camera. Clean the camera of any lint and replace any burned-out bulbs.
2	Set the scales on the head of the process camera to reflect the amount of reduction or enlargement you require in the finished image. Make sure the scales are accurately set.
3	Lift the glass from the copyboard and position the original copy.
4	Open the aperture wide open. This will increase the amount of light through the bellows and make focusing easier.
5	Adjust camera lights for even illumination.
6	Focus the image on the ground glass of the focal plane. Use a loup for critical focus.
7	Select an aperture setting and adjust the aperture ring.
8	Select a shutter speed and set the camera timer.
9	Turn off the lights in the darkroom.
10	Position the film on the film or focal plane with the emulsion facing the light source and close the camera back.
11	Turn on the vacuum to the copyboard and the film back.
12	Expose the film by tripping the shutter release activating the timer.
13	Turn off vacuum and lights.
14	Remove the film from the film plane.
15	Develop the film.

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Sheet film and print development

Sheet films and papers can be developed conventionally in a four-tray manual process or with an automatic processor.

Four-tray development

Conventional development of photographic sheet films and papers is a four-tray process. The first tray contains *developer.* Developer is a chemical that reacts with the film or paper to make images appear. The second tray contains *stop bath,* a weak acetic acid that neutralizes the action of the developer. The third tray contains *fixing agent.* The fixer stabilizes the developed image by chemically removing undeveloped light-sensitive crystals. The fourth tray contains *water.* Water removes chemicals from the film or paper. Allow films or papers to thoroughly rinse in water after development. If the water wash is insufficient, the film or paper continues to chemically change resulting in uneven streaking or browness.

Figure 7-5 illustrates the process for conventional development of sheet films and papers.

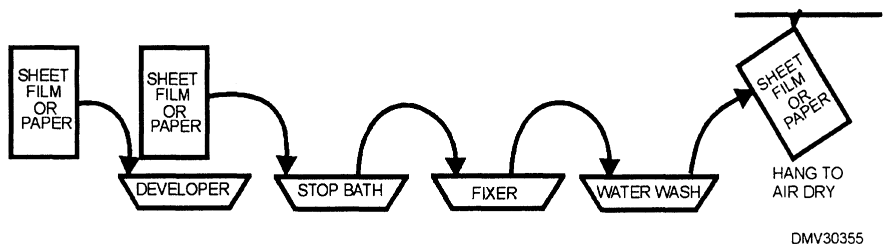

Figure 7-5.—Conventional development of sheet films and papers.

The temperature of each tray's contents should be approximately 70 degrees. Temperature variation between trays should not exceed 5 degrees. The warmer the liquids in the trays, the faster action takes place. The disadvantage of excessively warm temperatures is rapid overdevelopment. The disadvantages of cooler than required temperatures is slow development and weak images. Extreme temperature variations cause increased grain or reticulation. Do not put your hands into the chemicals. The warmth of your hands will raise the temperature of the solutions. Moving your hand from one tray to another will contaminate them. Use tongs to move the film or paper through the development process. Hang films and papers by one corner to air dry.

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Automatic sheet film and paper processing

Processing sheet films and papers with automatic processors is a two-step process involving *activation* and *stabilization.* After exposure, place the film or paper between the rollers of the automatic processor. The rollers guide the film or paper first through a tray of activator that develops the image, then through a tray of stabilizer. Finally, the rollers squeegee the excess chemical from the film or paper surface. Wash the film or print with clean cool water before hanging the print to dry.

Figure 7-6 shows the process of film or paper development in an automatic processor.

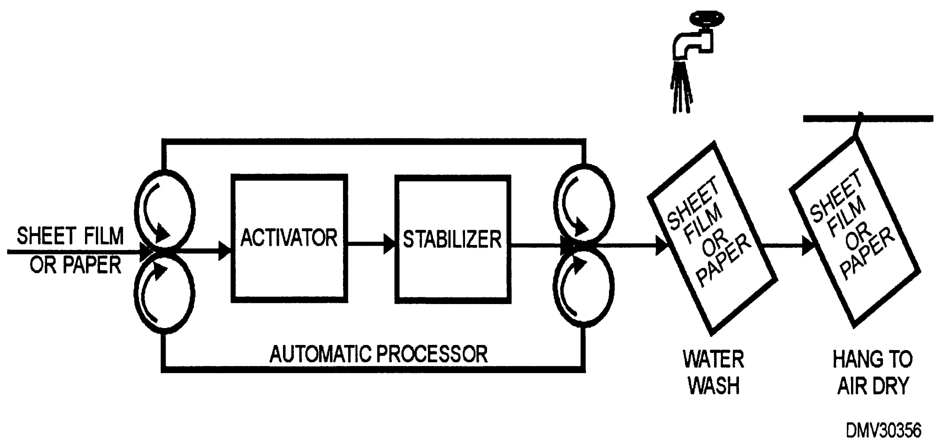

Figure 7-6.—An automatic processor for sheet films and papers.

Printing

Normally prints made from sheet films exposed by process cameras are on a one-to-one (same size) ratio. The print is later cut and pasted onto a layout and prepared for alteration or reproduction. Development procedures for prints is the same as development of sheet films.

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Process and Copy Cameras, Continued

Copy cameras Copy cameras are similar to process cameras but smaller. Many copy cameras are simply small-format cameras (lens and focal plane) on stands with copyboards (copy plane) and adjustable light systems.

Copy camera lenses Lenses for copy cameras are usually not interchangeable unless the camera used in the stand is a detachable small-format camera. Generally, copy camera lenses are 50mm in length with some lenses having super close-up (macro) capabilities.

Copy camera film backs The camera back or film plane may house 35mm, 120mm, or instant-imaging film. The film type used in the film back may be negative- or positive-imaging or color or black-and-white film or paper.

Copy camera adjustments Copy cameras adjust in the same way as small-format cameras. Load the film into the film back. Set the ISO and select a shutter speed and/or aperture.

Copy camera exposure Copy cameras have a shutter-release button or a cable release connected to the shutter-release button. The cable release minimizes camera movement when the shutter is depressed.

Figure 7-7 compares a shutter-release button with a cable release.

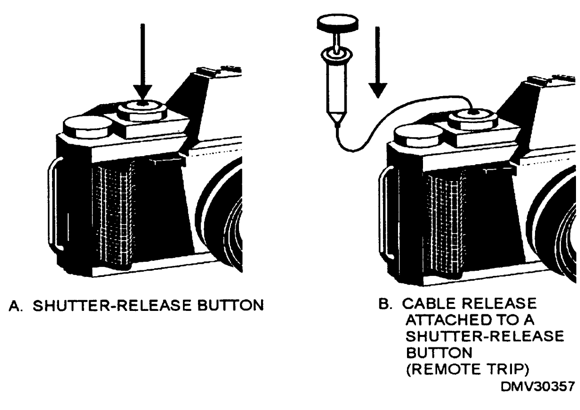

Figure 7-7.—Shutter releases: A. Shutter-release button; B. Cable release.

Electronic Cameras

Introduction

Computer technology has spawned a new photographic theory based on the principles of capture, enhancement, and display. With fleetwide restrictions on hazardous material and chemistry, you may find less traditional photographic methods and more electronic photography in graphics shops.

Electronic photographic capture

Electronic photography captures images as magnetic impulses. The two types of electronic cameras currently used in the Navy are the still-video camera and the digital camera.

STILL-VIDEO CAMERAS: The still-video cameras record images as magnetic impulses and place them on 2-inch floppy disks. Images are captured by two charged-coupled device (CCD) chips. One chip stores luminance information and the other separately records chrominance information. Still-video disks provide a 720,000-pixel image. Images are stored on the floppy disk as either a frame or a field. When selecting frame storage, each picture records on two tracks, and up to 25 images fit on one disk. Selecting field storage records each picture on one track, allowing up to 50 images on a disk. Recording in the field mode reduces clarity and resolution.

DIGITAL CAMERAS: Digital cameras capture images and transfer them to a highly sensitive CCD that converts them directly into digital information for storage in computer memory or on disks. Digital images easily download to computers for manipulation, enhancement, printing, or transmission without a loss in resolution.

Electronic imagery capture

Another form of electronic imagery capture is conventional photographic exposure and development, followed by electronic scanning, to convert the image into a digital format.

Electronic imagery enhancement

With the digital information in computer memory, processing software allows for corrections and enhancement similar to the alteration of photographs in the darkroom.

Electronic imagery display

Electronic images may be displayed on computer screens, transferred to slides or video tape, or printed on paper or film. Images may also be directly imported into documents using desktop publishing software. Store electronic images on floppy disks, compact disks (CD), or in harddrives.

Small-Format Cameras

Introduction

Often DMs are required to fill in for the duty photographer or to create and duplicate slides. The camera you use for this work is most often a small-format portable camera.

Small-format cameras

Small-format cameras refer to any cameras that produce negatives on a film size of 35mm or less. Generally hand-held and portable, small-format cameras allow maximum freedom of movement and large numbers of exposures without reloading the camera. The accessories, lenses, and flash equipment are easily carried. The most popular professional small-format cameras are the 35mm rangefinder and single-lens reflex (SLR).

Rangefmder cameras

Rangefinder 35mm cameras focus images on the film or focal plane after diverting light reflected from surfaces through a series of angled mirrors. The viewing lens and the lens through which the exposure is made are not the same. The difference between the offset position of the two lenses is called *parallax.* What you see in the eyepiece is not necessarily what you record on film. Most 35mm rangefinder cameras automatically correct any differences in parallax.

Figure 7-8 shows how images pass through rangefinder cameras.

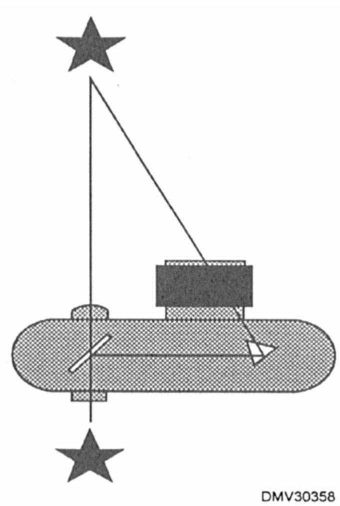

Figure 7-8.—How images pass through a rangefinder camera.

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Single-lens reflex cameras

In single-lens reflex cameras, or SLRs, the viewing lens is the same as the lens that records the image; hence the name, single-lens reflex. The viewing and exposure system of SLRs consists of three main elements: a hinged mirror, a matte focusing screen, and a five-sided glass prism called a pentaprism. Images enter the lens and strike the mirror. The mirror deflects the image through the pentaprism onto the matte focusing screen in the eyepiece. During exposure, the mirror flips out of the way allowing the light to record on film at the film plane.

Figure 7-9 shows how images pass through an SLR.

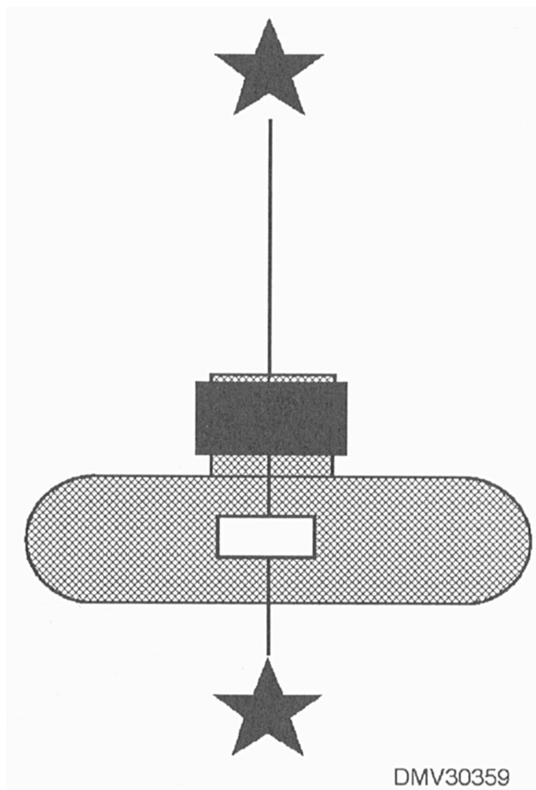

Figure 7-9.—How images pass through an SLR camera.

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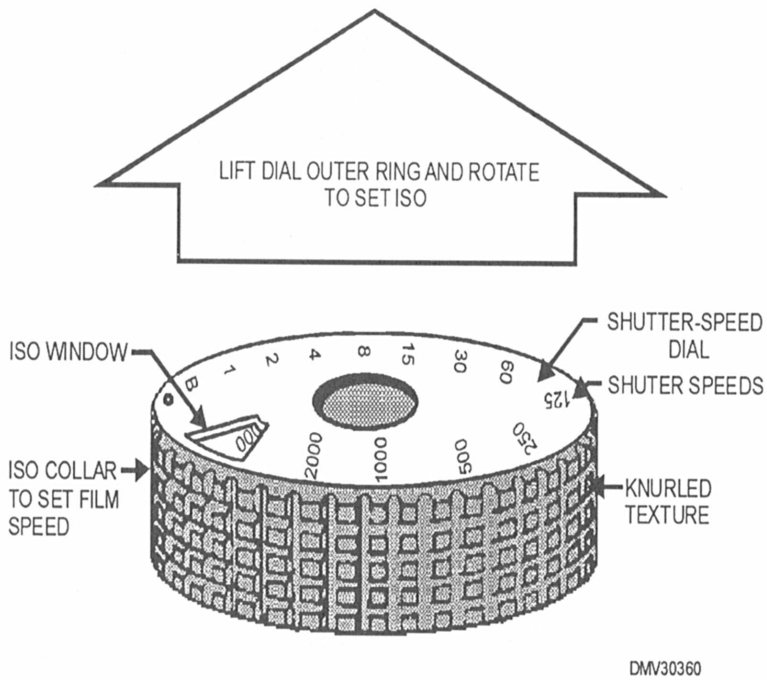
Camera adjustments

The body of 35mm cameras with interchangeable lenses have an ISO selection dial, a focal plane (shutter speed dial), a frame indicator, a film release, and a light meter. Focus rings and aperture rings are usually part of the lens.

ISO selection dial

The International Standards Organization rates each film for sensitivity by assigning it a numerical code. Located on top of a camera body is a small dial with numbers that incrementally increase or decrease by hundreds, for example, 200, 400, or 1000. Set the dial to the number that most closely corresponds to the ISO ratings on the film cassette you are using. Some cameras require the operator to lift the dial before turning it to the appropriate ISO number.

Figure 7-10 is an example of a film-speed dial.



Figurre 7-10.—Film-speed dial.

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Shutters

Camera shutters control both the exact instant film is exposed to light and the duration of exposure. The two types of camera shutters are the leaf shutter and the focal-plane shutter.

Leaf shutters

Leaf shutters consist of several blades of spring steel that overlap each other. Pressing the shutter release button rapidly moves the blades apart or open to allow light to strike the film. The blades remain open for the duration of the preset exposure time (shutter speed) before springing shut again. Leaf shutters may be used with a flash unit at all shutter speeds.

Figure 7-11 illustrates the operation of leaf shutters.

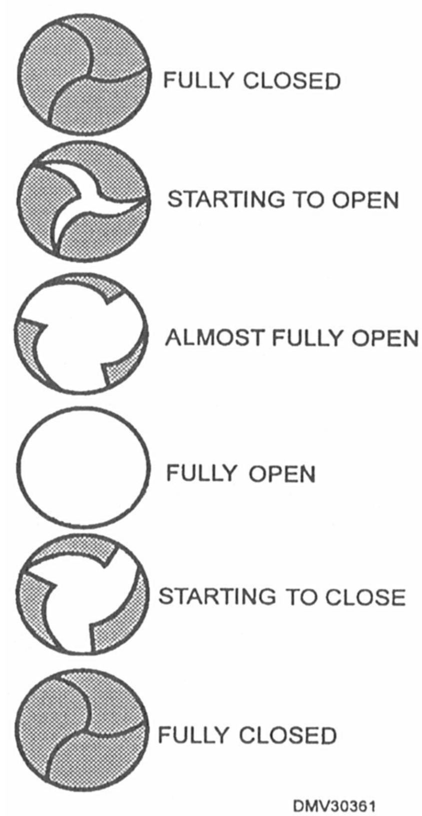

Figure 7-11.—Leaf shutter operation.

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Focal-plane shutters

Focal-plane shutters are essentially two light-proof cloth or thin metal curtains in front of the film plane that move across the film in the same direction. As the first curtain moves from one side to the other, the second curtain follows. The speed at which the curtains move is called shutter speed. When a slow shutter speed is set, the second curtain waits a relatively long time and the space between the first and second curtain is wide. Shutter speed dials are located on the camera body and indicate time in fractions of a second. Shutter, aperture, and mirror work together in a precise sequence that repeats each time the shutter release trips. Most 35mm cameras have focal-plane shutters. Focal-plane shutters simplify camera construction and make interchangeable lenses smaller, lighter, and less expensive than leaf shutters.

Figure 7-12 shows a focal-plane shutter.

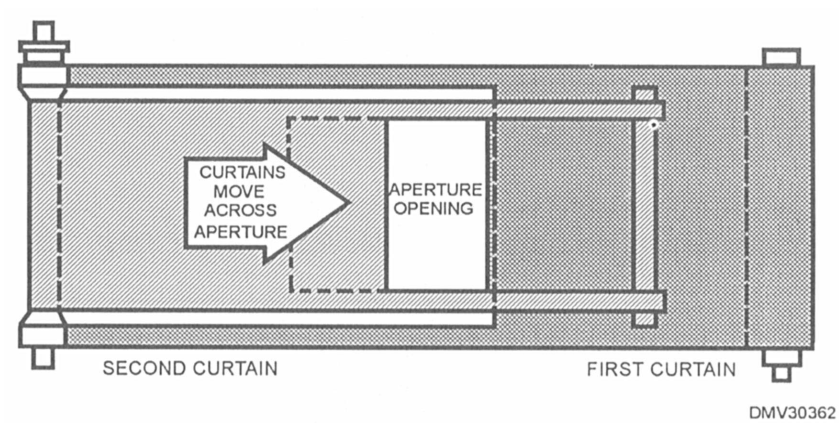

Figure 7-12.—Focal-plane shutters.

Frame indicator

The frame indicator is a small window near the shutter-speed dial that displays the number of pictures taken. Each time the back of the camera opens, the number resets to “0.”

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Film release

The film-release button, located on the bottom of camera bodies, releases the tension on the film roll winding inside the camera body. Make sure you depress the film release before attempting to rewind film into the canister or preparing a double exposure. Not releasing tension on the film will tear film and sprocket holes. The film release does not open the film back or expose film.

Light meters

A light meter inside the camera body reads the amount of light entering the lens and recommends an overall ideal aperture setting. Most 35mm SLRs have built-in light meters that read through the lens (TTL). Light meters may read light falling on the mirror, the shutter curtain, the focusing screen, or the film surface and produce a display in the viewfinder indicating the correct exposure setting. In the manual mode, set the lens aperture to correspond with the meter reading. In the automatic mode, the camera sets the exposure and informs you of the setting. To compensate for unusual lighting conditions or for creative effect, override the automatic selection and manually set the aperture. Light meters in 35mm cameras are ordinarily powered by batteries.

Figure 7-13 shows a light meter reading from the eyepiece of a camera.

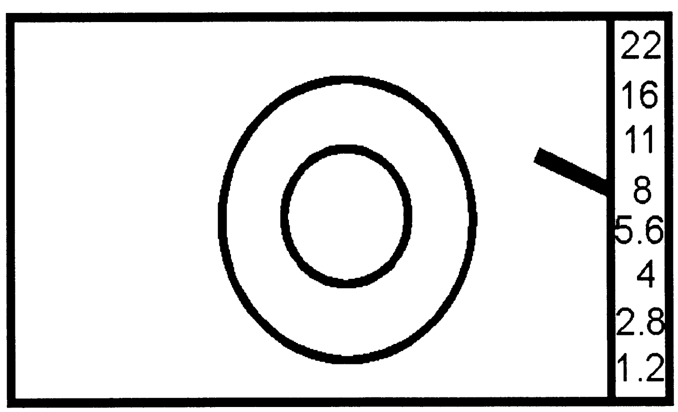

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Figure 7-13.—A TTL light meter reading of f/8 from the eyepiece of a camera.

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Small-Format Cameras, Continued

Using a 35mm camera

To use a small-format or 35mm camera:

Step	Action
1	Check the camera for cleanliness and battery freshness. Clean camera and replace battery, if required.
2	Set the ISO dial to correspond with the ISO rating of the selected film.
3	Open the film back and insert the film, with the leader on the bottom. Be sure to engage the film sprockets so that the film winds correctly on the empty right-hand spool.
4	Close the film back. Trip the shutter release and wind the film until it indicates the first frame in the frame counter.
5	Assess local conditions and set the shutter speed for the desired speed of exposure.
6	Select the proper lens and place it on the camera body clicking it into place.
7	Look through the lens at a subject for a test meter reading. Pushing the shutter release button partially down produces a meter reading in the eyepiece without tripping the shutter.
8	If you are not manually operating the camera, set the camera to the automatic mode by placing the "A" on the lens aperture ring across from the aperture indicator mark.
9	Expose the film. Make sure to wind to the next frame after each exposure so that you are always ready to shoot.
10	Depress the film release button before rewinding exposed rolls of film back into their canister and opening the film back to remove the film.

Shutter Speed

Introduction

Shutter speed and aperture settings control the quality of exposure in photography. Understand the effect one has on the other.

Shutter speed

Shutter speed is the amount of time, in fractions of a second, that it takes the opening in the shutter curtain to pass across the film surface.

Shutter speed settings

A dial on the camera body is marked with industry standard shutter-speed settings of T or Ž, B, 1, ½, l/4 l/8 l/15, l/30, l/60, l/125, l/250, l/500, l/1000, and l/2000. Select'the interval you want the shutter to remain open by moving a lever or dial to that particular setting. It should easily click into place. You cannot select a shutter speed in between two indicated speeds.

T or Ž: At the setting marked "T or Ž, " the shutter opens the first time the shutter-release button is pressed and remains open until the shutter-release button is pressed again.

B: At the setting marked "B," the shutter remains open as long as the shutter-release button is held down and closes when released.

l/30: This setting is the longest recommended shutter speed for hand-held exposures. For any setting longer than l/30 second, set the camera on a tripod or sturdy support.

l/60: This is generally the recommended shutter speed for flash photographs. At this speed, the shutter speed, aperture, and flash are synchronized for optimum exposure. Flash synchronization may also be indicated by numbers in red or another color or by a lightning bolt on the shutter speed dial.

Long (slow) shutter speeds: Slower shutter speeds (T or Ž, B, 1, l/2, l/4, l/8,, l/15, and l/30) require more stable platforms or tripods to minimize blur. Not intended to stop action, slow shutter speeds work best in low light situations with little movement. The results can be very fine grain, overall image sharpness, and subtle gradations of tone.

Short (fast) shutter speeds: With faster shutter speeds (l/60, l/125, l/250, l/1000, and l/2000), the faster the shutter speed, the more likely you are to stop action. One drawback to faster shutter speeds is that less of the overall image will be focused.

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Shutter speed dial

Figure 7-14 shows a shutter-speed dial.

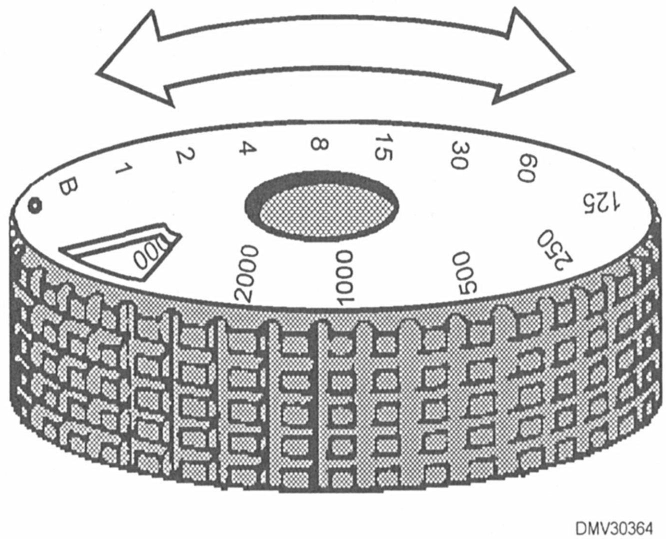

Figure 7-14.—A shutter-speed dial.

Trouble-shooting causes of blur

The following table lists common shutter-speed problems resulting in blur.

Appearance	Cause	Correction
Subject blurry, background or some of the picture in focus.	Subject moved. Photographer focused on wrong subject.	Stabilize subject. Refocus on subject.
Background blurry, subject or central image in focus.	Out of depth of field.	Use a slower shutter speed or different f/stop.
Everything blurry.	Camera moved.	Stabilize camera. Use a faster shutter speed.

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Shutter Speed, Continued

Recommended shutter speeds

The following table lists recommended shutter speeds for objects moving in the scene.

Speed MPH	Action	Distance (in feet)	Direction of action across field of view/diagonally/straight toward or away
5	Slow walk, moving hands	12 25 50 100	l/500 l/250 l/125 l/250 l/l25 l/60 l/125 l/60 l/30 l/60 l/30 l/15
10	Fast walk, slow-moving vehicles	12 25 50 100	l/1000 l/500 l/250 l/500 l/250 l/125 l/250 l/125 l/60 l/l25 l/60 l/30
25	Running, sports, very active people, vehicles moving at a moderate rate of speed	12 25 50 100	l/2000 l/l000 l/500 l/l000 l/500 l/250 l/500 l/250 l/125 l/250 l/125 l/60
100	Very fast activity	12 25 50 100	l/2000 l/2000 l/1000 l/1000 l/l000 l/500 l/500 l/500 l/250 l/250 l/250 l/125

Aperture

Introduction

Aperture settings are related to and work in conjunction with shutter speeds. Understanding the relationship between the two factors should improve your ability to shoot correctly exposed films and papers with less effort.

Aperture

The aperture regulates the diameter of a lens opening. The diameter of the lens opening controls the amount of light or luminance that strikes the film plane. Aperture is also referred to as *f/stop.* The term f/stop expresses the relationship between the focal length of the lens and the diameter of the aperture opening. The most commonly used aperture-control device is the *iris diaphragm.*

Iris diaphragm

The iris diaphragm is an adjustable device that fits into the barrel of a lens or shutter housing. It consists of a series of thin, curved, metal blades that overlap each other and fasten to a control ring on the lens barrel. The blades of the diaphragm move in unison as the control ring rotates, forming an aperture opening of any size. An iris diaphragm resembles the iris in the human eye; hence the name, iris diaphragm.

Figure 7-15 shows how similar the iris diaphragm is to the human eye.

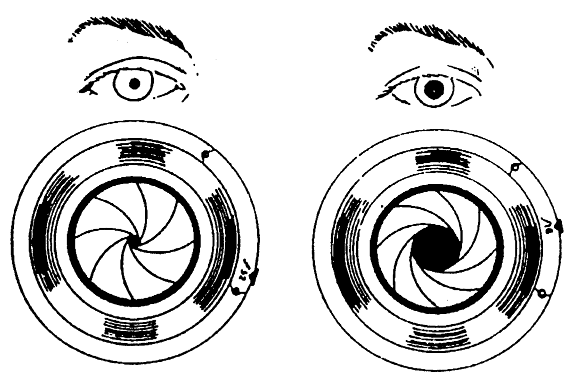

Figure 7-15.—Iris and iris diaphragm under light: A. Bright light; B. Low light.

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Aperture settings

Aperture settings (f/stops) regulate the intensity of light allowed to strike the film surface. The aperture control ring on the lens barrel is marked in a series of f/stops that relate to the openings of the iris diaphragm. F/stops control overall image sharpness, depth of field, and partially correct lens aberrations. Adjacent numbers in the series of f/stops admit light in a proportion of 2 to 1. For example, changing aperture setting from f/5.6 to f/8 changes the amount of light by decreasing the light by half, a procedure called *stopping down.* Changing from f/5.6 to f/4 doubles the light. This change is called *opening up.* When the diaphragm is set to its smallest numerical aperture, it is said to be *wide open.* The larger the f/stop numbers, the smaller the opening and the less light admitted.

Figure 7-16 illustrates the differences between f/stop openings.

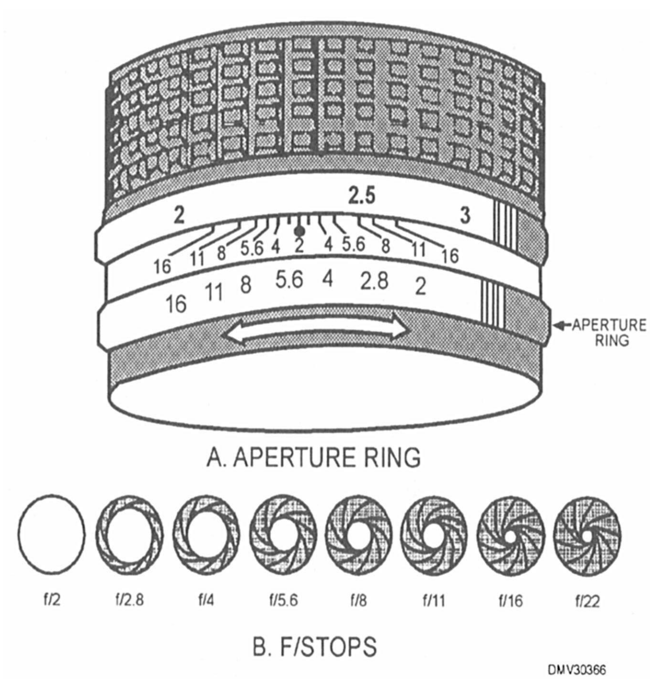

Figure 7-16.—Aperture: A. Aperture ring; B. Aperture openings at various f/stops.

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Aperture settings without light meters

There may be times when you do not have access to light meters or the light meter in your camera is not working. You can improve your chances of taking usable exposures if you follow the f/16 rule. The f/16 rule is based on the correct exposure for an average front-lighted subject under bright, sunny conditions.

To use the f/l6 rule:

Step	Action
1	Set the aperture of the camera to f/16.
2	Set the shutter speed on the camera to most closely approximate the rated ISO of the film. For example, if the film is rated at ISO 125, set the shutter speed at l/125 of a second.

The f/16 rule is a way to calculate alternate f/stops should environmental conditions deteriorate. The following table lists different aperture settings for daylight conditions.

Condition	f/stop
Bright sun, light sand, or snow	f/22
Bright sun	f/16
Cloudy but bright	f/11
Cloudy	f/8
Overcast or open shade	f/5.6

Lenses

Introduction

Selection of the appropriate lens for the job ensures optimum resolution in reproduction. If you duplicate slides or photographs without available negatives, your selection of lenses could mean the difference in doing a good job or not being able to do the job at all. Review Illustrator Draftsman Volume 1, chapter 1, for elementary information on lenses.

Lens interchangability

Lens interchangability is one of the best features of SLR cameras. When you cannot change your viewpoint or the position of the camera, or when different focal-length lenses will enhance your subject, change lenses. Most SLRs are designed with an manufacturer-exclusive method of lens attachment. Some SLR manufacturers use screw-mounts; others use bayonet mounts. Lenses from different manufacturers are either incompatible or require special adapters to fit the camera body or align electronic contacts. Do not force lenses onto camera bodies. Forcing lens mounts may irrepairably damage the electric contacts that feed light meter, shutter speed, and aperature information into the camera.

Lens characteristics

Lens characteristics define lenses. Focal length, aperture and lens speed, and depth of field are characteristics that combine to influence the images you create.

Focal length

Focal length is the distance between the optical center of a lens and the focal plane (film plane) of the camera when the lens is focused at infinity. To understand this definition, you must fully understand the terms *focal plane, optical center,* and *infinity.*

- Focal plane -The surface or area at the back of the camera occupied by film on which images transmitted by a lens are brought into sharp focus.

- Optical center -The optical center of a lens is a point, usually (although not always) within a lens, where light rays from two different sources entering the lens are assumed to cross.

- Infinity -Infinity is a distance so far removed from the camera that the light rays may be regarded as parallel. Infinity is expressed by the symbol 60 and is a setting on a camera focusing scale.

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Focal length (Continued)

Figure 7-17 shows the focal length of a standard 50mm lens.

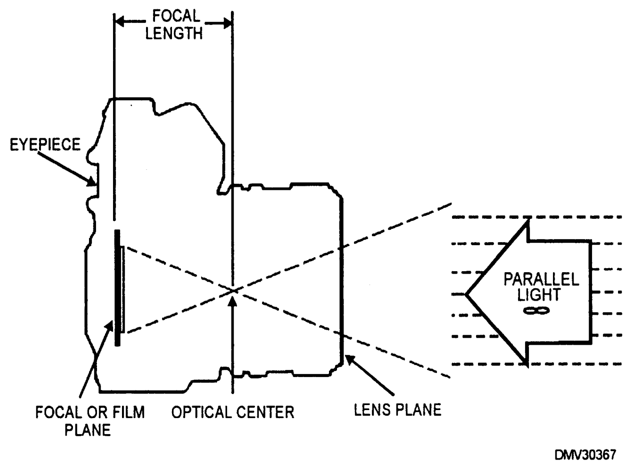

Figure 7-17.—The focal length of a standard lens.

Focal length, imprinted on the lens mount at the front of the lens barrel, is sometimes expressed in inches, sometimes in millimeters (mm), and occasionally in both systems.

Figure 7-18 shows a lens barrel with the imprinted focal length of the lens clearly visible.

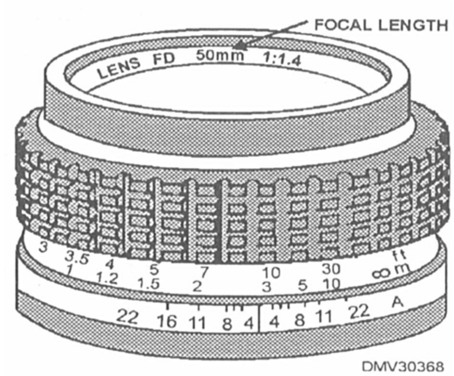

Figure 7-18.—A lens barrel showing the focal length designation.

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Lens range	Lens range refers to focal length, or the distance between the lens plane and the focal plane. Lens ranges may be fixed or variable. Fixed lenses have focal lengths that do not change. Lens ranges may be long, short, standard, or macro. Variable lenses have changeable focal lengths to zoom images closer or farther away.
Long-range lenses	Long-range lenses are lenses with focal lengths greater than 58mm. Most long-focal-length lenses are called *telephoto* lenses. Use these lenses to draw images closer. Lenses ranging from 85mm to 105mm are used for portraiture because they create the most natural images of people, without excessive distortion. Ideal for action or sports photography, long-range lenses require more light and faster film than standard lenses.
Short-range lenses	Short-range lenses are lenses with focal lengths less than 50mm. Short-range lenses include wide-angle lenses (less than 40mm in focal length), and ultra-wide-angle lenses, called *fisheye* lenses, with focal lengths of 17mm or less. Shorter focal-length lenses magnify features nearest the camera to the point of apparent distortion. Wide-angle lenses are indispensable for filming in confined spaces and panoramic views. Use a lens hood to shade wide-angle lenses from glare.
Standard-range lenses	Standard-range lenses have focal lengths between 50mm and 58mm, with the most common focal length being 50mm. Standard-range lenses most closely record images as the human eye would see them. Distortion is negligible.
Macro lenses	The most popular macro lenses have focal lengths of 50mm and 100mm. Use a macro lens for close-up photography such as copy work. With 100mm macro lenses, you do not have to get as close to the subject as with 50mm macro lenses. The extra distance 100mrn macros provide is especially useful when taking pictures that present hazards. Macro lenses perform well and offer greater versatility when used as general-purpose lenses in routine shoots.

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Variable lens

Lenses with changeable focal lengths are called *variable* or *zoom* lenses. The photographer pulls, pushes, or twists a sleeve around the barrel of the lens. The aperture and focusing rings are coordinated and move in unison with the focal-length sleeve. This lens is indispensable when shooting in conditions that change too rapidly to manually change lenses.

Lens coverage

Focal length is a determining factor in the coverage of the lens. The maximum image coverage at the focal plane of a lens is expressed in degrees and known as the *angle of field.* The angle of field is the widest angle at which light entering a lens produces a usable portion of illumination at the focal plane. Beyond the angle of field, light becomes less intense and image sharpness decreases. The angle of field is similar but not the same as the angle of view. The angle of view (also in degrees) is the amount of image coverage of a lens on the focal plane within a particular film size. The angle of view should not exceed the angle of field.

Figure 7-19 illustrates the different angles of view.

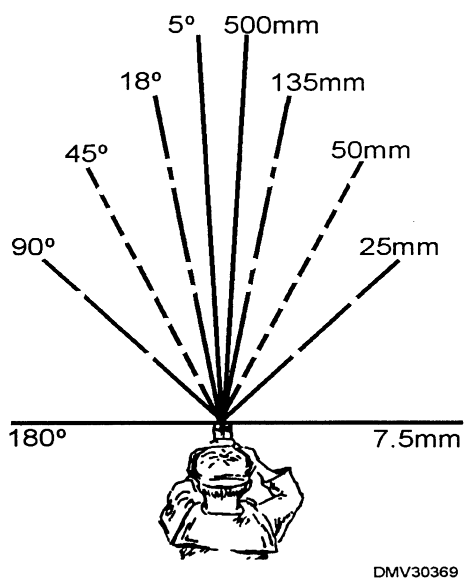

Figure 7-19.—Angles of view available with focal lengths shown.

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Lens apertures

Aperture openings are located on a ring or collar around the lens barrel. The size of the largest opening, called the maximum working aperture of the lens, is referred to as *lens speed.* Apertures also influence depth of field.

Depth of field

Depth of field is the distance from the nearest point of acceptably sharp focus to the farthest point of acceptably sharp focus. Depth of field depends on the focal length of the lens, the f/stop setting, and the distance at which the lens is focused. Depth of field is greater with short-focal-length lenses than with long-focal-length lenses. As aperture decreases, depth of field increases. It is more important to focus accurately on nearby objects than for distance objects. When you want maximum depth of field, focus the lens on the hyperfocal distance or infinity for the f/stop used, not on the subject. To preview depth of field before exposure, depress the preview button or partially depress the shutter release to stop down the aperture. An estimate of depth of field is shown on the aperature ring on most cameras. The ring shows an approximate range for depth of field.

Figure 7-20 shows depth of field.

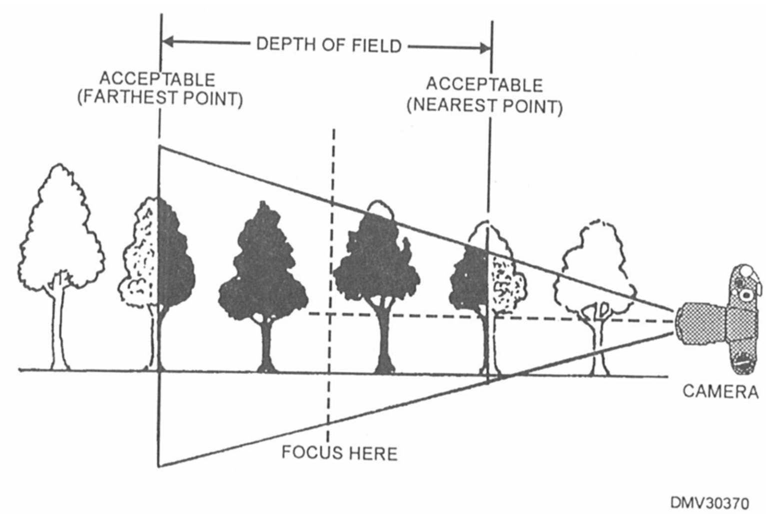

Figure 7-20.—Depth of field.

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Depth of field (Continued)

Figure 7-21 shows the aperture set at f/8 on a standard lens. The depth of field when focused on a centered subject extends from just in front of the subject (at 2½ feet) to just behind the subject (at 5½ feet). At f/16, the depth of field increases to just over 2 feet to 10½ feet.

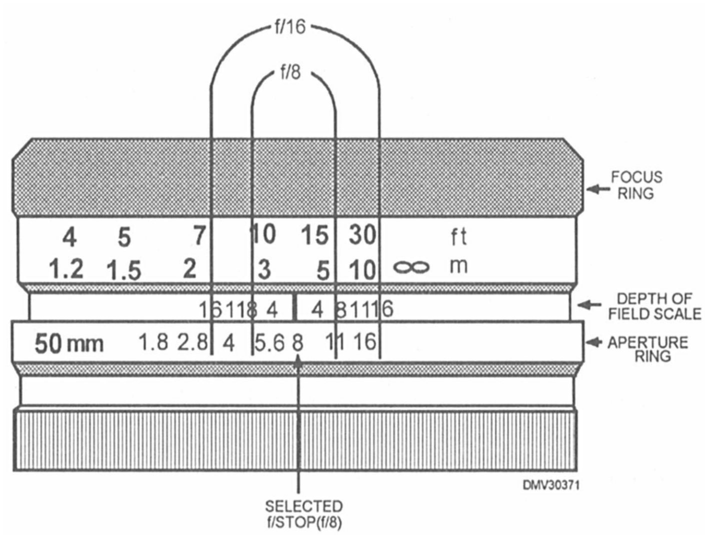

Figure 7-21.—Reading depth of field.

Use this table for guidance in increasing or decreasing depth of field.

Decreasing depth of field	Increasing depth of field
Use a larger f/stop (lower number).	Use a small f/stop (higher number).
Use a longer focal-length lens.	Use a short-focal length lens.
Move closer to the subject.	Use a faster film or slower shutter speed or a smaller f/stop.
	Focus at the hyperfocal distance or infinity.

Films

Introduction

Selection of an appropriate film requires knowledge of film characteristics, lighting situations, and potential compromises. There are many types of conventional films to choose from as well as video disks.

Film

Film is an emulsion of light-sensitive silver halide salts on a translucent or transparent acetate base. When struck by light, the emulsion hardens and deforms recording a latent or invisible image. Chemical additives in the emulsion determine the range or wavelength of light to which the film responds. The image visibly appears only after chemical development.

Black-and - white fiiii composition

Black-and-white film is a light-sensitive emulsion on a transparent or opaque base used to photograph reversals (positive) or negative images. In addition to the emulsion and the base, there are three additional layers of substances that perform special functions. Overcoating, antihalation backing, and noncurl coating complete the five component parts of black-and-white photographic film.

EMULSION: The emulsion contains light-sensitive silver salts called silver *halides.* Silver halides react to ultraviolet (UV) radiation, violet, and blue light only. They can be made sensitive to other colors of light and infrared radiation (IR) by the addition of dyes. A gelatin evenly disperses the silver halides and dyes onto a base.

BASE: The film base holds or supports the emulsion.

OVERCOATING: Overcoating is a clear layer of gelatin that protects film from friction, scratches, or abrasion. The overcoating is sometimes called the antiabrasion layer.

ANTIHALATION BACKING: The antihalation backing prevents light from reflecting from the base back into the emulsion.

NONCURL COATING: The noncurl coating is a hardened gelatin applied to the back of the film that prevents the film from curling during the drying process.

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Color film

Color film also consists of a light-sensitive emulsion on a transparent or opaque base used to record images. The main difference between color and black-and-white films is that color emulsion consists of three distinct layers. Each of the three layers of emulsion records one of the three additive primaries - red, green, or blue. Modern films have fast and slow emulsion layers for each primary color to improve film speed and resolution. Color films produce reversals (positive) or negative images.

COLOR REVERSALS: Color reversal films produce positive images in densities directly proportional to the objects in a scene. Reversal films contain the suffix "chrome" in their name. Development of color reversal films is a two-stage process. Developed color reversal film can be used as transparencies (slides) for direct viewing, printed directly onto color reversal paper, copied on black-and-white films for producing black-and-white prints, or copied onto color internegative (copy negative) for producing color prints.

COLOR NEGATIVES: Color negatives record scenes in image densities opposite to the brightness of objects in a scene. Most color negatives have an orange mask that increases color separations producing colors more accurately. Color negative films contain the suffix "color" in their name. Color negative images can be printed on color positive materials such as color-paper and color-print film to produce color prints or transparencies. Color negatives can also be printed on special panchromatic black-and-white paper to produce black-and-white prints.

Film format

The two basic film formats commonly used in the Navy are roll film and sheet film. Both formats come in a variety of sizes. Both film formats are available in black-and-white or color.

Roll film

Roll film is film packaged so that it may be loaded and unloaded from a camera in daylight. Number 120 roll film has a paper backing that prevents inadvertent exposure; 35mm film is wound in light-tight cassettes. The most common film size, 35mm, comes in prepackaged cassettes in lengths producing 12, 20, 24, and 36 exposures or frames per roll. Also, 35mm film comes in 100-foot rolls for bulk loading into reusable cassettes.

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Sheet or cut film

Sheet or cut film is made in a variety of sizes from 4 by 5 to 11 by 14 inches and larger. Sheet film does not have a paper backing and must be loaded and removed from film holders in total darkness. Most sheet films have notches in one ‘edge of the film to identify film type and emulsion side when in the dark. Emulsion to emulsion contact or emulsion toward the copy produces the sharpest images. The emulsion is toward you when the notches are on the top edge, upper-right corner of the film or the bottom right edge, lower-right corner of the film. For sheet films without notches, the emulsion side of the film can be identified by its lighter color when viewed under a safelight. If the emulsion side of the film must be identified in total darkness, wet your lips and place the edge of the film between them. The emulsion side of the film will stick to one of your moistened lips.

Video disks

Most electronic cameras use compact, 2-inch, still-video floppy disks to record images as magnetic impulses. Video disks do not contain emulsions or a base. The camera and the printer determine whether an image is black and white or color. Pictures are recorded in either the frame or field mode in the camera. The frame mode records each image on two tracks. Twenty-five images fit on one disk in the frame mode. In the field mode, each image records on one track so 50 images fit on one disk. The quality of frame-recorded images is superior to that of the field-recorded photograph. Floppy disks used in electronic imaging may be reused endlessly. No chemicals or darkroom techniques are required. Once captured on disk, an image can be transmitted over telephone lines, edited, and printed - all under normal room light.

Film characteristics

Film characteristics are determined by the films degree of sensitivity to light, response to various colors of light (color or spectral sensitivity), contrast, exposure latitude, emulsion latitude, and emulsion definition. The characteristics and use of black-and-white films depend largely on the construction of the emulsion.

Emulsion sensitivity

Film emulsions are very sensitive to low levels of light. The light causes invisible changes to the emulsion. These changes or images are called *latent images.* Latent images become visible after chemical development. The property of a film emulsion to respond to light is termed *film speed.*

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Film speed

Film speed indicates the ability of the film emulsion to record latent images. The International Standards Organization (ISO), a federation of all the national standard bodies of the world, uses a uniform set of film speed standards to rate film. This is referred to as an ISO number. This ISO number generally looks like the following: ISO/21°. The ISO number assigned to the film is displayed on the film canister, packing material, and exterior packaging. Lower ISO numbers indicate slow films, while high ISO numbers indicate faster films.

FAST FILMS: Films considered “fast” is film that requires little light for correct exposure. These low-light film speeds have ISOs of 400 and higher. Image resolution is good in small prints; however, pronounced graininess appears in enlargements. Some of the very fast films, ISO/1000° and faster, need very little light and extremely short exposure times. Fast films are difficult to handle in bright light sitiuations but highly desirable for dimly lit subjects.

SLOW FILMS: Slow films require more light or longer exposures to record images. Slow films, such as ISO/25°, display very fine grain that remains fine even in enlargements. These films are ideal in controlled studio environments.

Spectral sensitivity

The response of an emulsion to specific colors of light or radiant energy is termed *color* or *spectral sensitivity* including ultraviolet and infrared radiation as well as visible light. Color sensitivity in black-and-white films controls the way colored objects record as tones of grey in the negative or print. Color sensitivity determines how a film is classified into the four general categories of monochromatic (colorblind), orthochromatic, panchromatic, and infrared.

MONOCHROMATIC (COLORBLIND) EMULSIONS: Monochromatic emulsions are sensitive only to UV radiation, violet, and blue light. Used for copying and graphic arts continuous-tone and line (halftone) photography, monochromatic films may be assigned three or more ISO values; for example, ISO/50° for daylight, ISO/8° for tungsten light, ISO/20° for white-flame arcs, and ISO/l2° for pulsed xenon lighting. The ISO value you use depends upon the lighting system of your copy or process camera.

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Spectral sensitivity (Continued)

ORTHOCHROMATIC: Orthochromatic films are sensitive to ultraviolet radiation, violet, blue, and green light. The emulsion provides approximately correct reproductions of blue and green objects in corresponding tones of grey in daylight or tungsten light. Used primarily for copy work and graphic arts photography, orthochromatic film trade names usually contain the word “ortho.” Ortho-type films may be used as continuous-tone or halftone (line) film.

PANCHROMATIC: Panchromatic films are sensitive to UV radiation, violet, blue, green, and red light. Panchromatic films are used for copy work, portraiture, and general photography. These films have only one ISO speed.

INFRARED: Infrared film emulsions are sensitive to UV radiation, violet, and blue light, with little sensitivity toward yellow-green light. Sensitivity to red and infrared light is heightened. Infrared film is used for aerial and medical photography. Since infrared radiation does not focus at the same point as visible light, a lens focus adjustment is necessary for critical focusing. Most lenses have a calibrated IR-focusing position on the depth-of-field scale marked by a small dot or the letter “R” in red.

Figure 7-22 shows the calibrated focus adjustment required to compensate for infrared film.

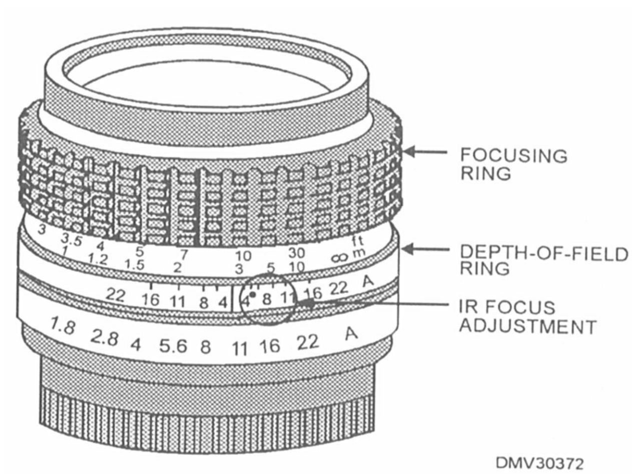

Figure 7-22.—The calibrated focus adjustment indicator for infrared films.

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Film contrast

Film contrast is the difference in density between areas in negatives. After development, grains of silver halides remain in film but are redistributed to create tonal areas of grey. These grey areas range from very dense to very thin, depending on the brightness of the objects in the scene. The portions of negatives where the most silver halides are affected are referred to as *highlights*. The portions that are least affected are called *shadows*. Light reflections from objects other than the brightest and the darkest are referred to as *midtones*. The amount of metallic silver deposited in any portion of a negative is referred to as *density*. Density describes the light-stopping ability of a negative.

Film emulsion latitude

Emulsion latitude is the ability of a film to record a range of scene brightness differences as density differences. Normal- and low-contrast emulsions record a wide range of brightness. High-contrast films record a short range of brightnesses and are considered to have a narrow latitude.

Film exposure latitude

Exposure latitude is the amount of departure (increase or decrease) from the ideal exposure setting the film will allow while still producing negatives of acceptable contrast.

Film emulsion definition

Emulsion definition is the ability of films to produce clear, sharp images. Emulsion definition includes graininess, resolving power (resolution), and acutance (the ability to produce sharp edges).

GRAININESS: Graininess is a speckled, mottled, or granular appearance on the surface of negatives that is magnified in prints. The amount of apparent grain depends on the size of silver halides, the exposure the film received, and the clumping of the silver grains during development. Extreme graininess is called *reticulation* and may be used creatively to add interest to a layout.

RESOLUTION: Resolution is the ability of films to record fine detail. The resolution or resolving power is expressed as line pairs per millimeter. As negatives are enlarged, resolution lessens and grain increases. This softening of the image becomes most apparent when cropping 35mm negatives and enlarging them in print.

Continued on next page

Film emulsion definition (Continued)

ACUTANCE: Acutance is the objective measure of the ability of photographic material to show a sharp linear demarcation between contiguous areas receiving low and high levels of exposure to light.

Color film balance

Color film balance is the acceptable relationship among the three color primaries in positive color prints or slides. In other words, if the color appears correct, the color is visually balanced. Color films are referred to as daylight (outdoor) or tungsten (indoor) film indicating their broad use without filters. Daylight film is specifically balanced for use in sunlight or with electronic flash. Tungsten films are balanced for use with artificial illumination from camera or copystand lights. Using the wrong color balance film will make slides and prints appear off-color.

Film handling

Handle film only by the film edges to minimze fingerprints and the build-up of static electricity, which appear on prints as white (undeveloped) areas. Keep film in its protective package or canister until needed. Protect film surfaces from dust, lint, fingerprints, abrasions, and scratches.

Film date expiration

Films are manufactured to provide optimum color balance when purchased. That is when a film is said to be fresh. Film emulsions are made up of many different chemicals that deteriorate slowly over time. From the day of manufacture, all films begin to change; and as films age, film characteristics change. Manufacturers mark expiration dates on film packaging to indicate when film is no longer fresh. Film is intended for prompt processing to prevent any significant shift in color balance before development.

Film storage

Store film as a first-in first-out product and refrigerate, if possible. Use film with near expiration dates first. Refrigeration keeps film near the optimum color balance, retarding deterioration, until used. Remove film from refrigeration approximately 90 minutes before loading into a camera. Allowing films to attain room temperature will prevent brittleness and cracking. It will also prevent condensation from forming on film surfaces that may fog pictures taken before the film has a chance to warm.

Papers

Introduction

Papers, like films, have different characteristics. Some basic knowledge and common sense regarding the handling of light-sensitive papers will make your darkroom experiences less frustrating.

Black-and-white paper emulsion

Black-and-white papers consist of emulsion on a paper base. Images on black-and-white films are usually negative or recorded in tones of grey in reverse of the reflective brightness of a scene. Projecting negative images onto black-and-white papers results in positive images recorded in tones of grey relative to the reflective brightness values in the original scene.

Color paper emulsion

Color papers consist of a three-layered emulsion on a paper base. Color printing papers are for printing color negatives or color transparencies. Like color films, color printing papers can be identified by the suffixes “color” for color prints and “chrome” for color transparencies.

Paper format

Photographic printing papers (both in black-and-white and color) are manufactured in various cut-sheet sizes ranging from 5 by 7 to 20 by 24 inches and rolls up to 1,000 feet long.

Paper characteristics

Paper characteristics are similar to film characteristics and these characteristics are emulsion sensitivity, spectral sensitivity, contrast, and paper surfaces. The performance and use of photographic printing papers depend on the characteristics of the paper.

Paper emulsion sensitivity

Paper emulsion sensitivity refers to the responsiveness of a paper to light. The emulsions used for printing papers are slower or less sensitive to light than most film emulsions. A high sensitivity to light is not required or desirable. Slower paper emulsion sensitivity allows for some exposure manipulation during the printing process to correct incorrectly exposed negatives. Exposure manipulation that results in more light given to an area is called *burning in. Dodging* is the term used when light is selectively shielded from specific areas on the paper during exposure.

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Paper spectral (color) sensitivity

Paper spectral sensitivity is the ability of a paper to respond to specific colors of light. The terms *monochromatic* (colorblind), *orthochromatic,* and *panchromatic,* used to describe the spectral sensitivity of films, also apply to photographic papers. In selecting black-and-white papers for printing, spectral sensitivity is not a factor. Black-and-white papers may be handled in the darkroom under a (manufacturer-recommended) soft light called a *safelight.* In selecting color-print papers, spectral sensitivity determines whether or not to use a safelight and what color safelight to use.

Paper contrast

Paper contrast is the ability of a paper to produce images that replicate the highlights, shadows, and midtones found in the original scene. Navy imaging facilities and graphic shops use papers called *variable-contrast* papers. These papers have two emulsion layers, a high-contrast layer and a low-contrast layer, that make achieving the correct contrast in prints easier.

Paper surface

Paper surface refers to the physical texture of paper and the coating on the surface of paper. Photographic papers are available in a wide variety of paper surfaces, such as matt, semimatt, lustre, high lustre, pearl, and glossy. Textured papers that resemble canvas, linen, and brush strokes are also available. The most common papers in graphics shops are glossy and matt.

GLOSSY: Papers that have smooth glossy surfaces provide prints with high contrast and high-density color saturations, resulting in apparently sharper images. This occurs because glossy papers reflect light directly. Glossy papers are used for photographic prints that must show fine details, such as equipment damage, intelligence photos, or small photographs of cluttered scenes.

MATT: Light reflected from matt papers is diffused, providing softer, lower contrast in the images. Details do not appear sharp. Matt-surfaced papers are commonly used in portraiture and expansive scenes.

The surfaces of papers used by the Navy are coated with either polyethylene or resin. Papers are coated on both sides of the base. This clear coating protects papers from abrasion and from sticking to each other during the processing procedure. You may write on polyethylene papers with pencils, pens, or markers. Resin-coated (RC) papers require you to use markers with special inks that adhere to slick RC surfaces.

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Paper handling

When handling photographic papers, take care not to leave fingerprints, abrasions, or scratches on paper surfaces. Handle photographic papers only by their edges. Prevent unnecessary contact with the emulsion side of papers. Protect papers from dust and lint by leaving the paper in its protective packaging until needed.

Paper expiration

Paper emulsions, like any light-sensitive materials, should be exposed and printed before they pass the manufacturer's recommended expiration date. Use papers on a first-in first-out basis. Leave papers in their packages until needed. Papers stored in unfavorable conditions or that have expired may have a loss of emulsion speed, undesirable contrast changes, stains, color shifts, or high gross or intense fog.

Paper storage

Store paper packages in a refrigerator, if possible. Papers are packaged in humidity-sealed boxes to protect papers from relative humidity (RH). When the RH exceeds 60 percent, packages, labels, and emulsions become damaged by molds and fungi. Do not store foods or liquids in the same refrigerator as films and papers because they raise the relative humidity of the refrigerator. After removing photographic paper packages from the refrigerator, allow them to warm to room temperature before use. This warm-up period should be from 10 hours to overnight. Papers used before they have sufficiently warmed to room temperature may be difficult to process or exhibit high gross fog.

Finished Prints

Introduction

You may not need to use the entire image in a photograph. You should know how to select portions of or scale photographs inside and outside the darkroom.

Cropping

Cropping is the procedure of defining a desired image area within a larger image area. Crop photographs when the original image contains more information than desired and select a specific portion of the image to enhance the finished print. Photographs may be cropped in the darkroom or outside of the darkroom.

Cropping in the darkroom

To crop photographs in the darkroom requires a negative. The negative is necessary to project and enlarge the image before exposure to paper. Place the negative in the enlarger and raise the enlarger head until the selected portion of the image appears in the desired size on the print frame. Turn off the light in the enlarger, place the print paper in the print frame, and expose. The developed print will be cropped as you desired. One of the advantages of cropping in the darkroom is less paper waste. A disadvantage of cropping in the darkroom is that by increasing the image in the enlarger, grain also increases in the print and lessens resolution.

Cropping outside of the darkroom

If you have been given prints to work with instead of negatives, you may have to crop images outside of the darkroom. A simple method of cropping involves two pieces of white cardstock, each cut in an “L” shape. By maneuvering these two pieces of angled paper, called *cropping arms, you* may frame the desired portion of the image in many ways. If possible, mount photographs on cardstock. Place the cropping arms on the image and move them until you have framed the desired portion. Indicate crop marks on the cardstock border.

Indicating crop marks

Indicate crop marks on photographs by lightly marking the borders around the photograph, marking an overlay attached to the print, or cutting a window in opaque masking paper to expose the desired portion of the print. If you must mark on photographs, use a grease pencil so that the marks may be easily removed. Do not mark more than one set of crop marks on an image.

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Scaling artwork

Scaling is a term used for calculating dimensions for the reduction or enlargement of an entire given image. The entire image is proportionately enlarged or reduced. The most common methods of scaling outside of a darkroom are the diagonal line method and the scaling wheel, which is often called a *proportional scale.*

Scaling images in the darkroom

If you have a negative to print images from, scaling is easily accomplished in the darkroom as part of the projection and exposure process. It is simply a matter of selecting the finished size of the print and projecting the image to that size on the print frame before exposure. An advantage of scaling images in the darkroom is that grain and resolution enlarges or reduces proportionately. The disadvantage is not seeing the final scaled image before developing the print.

Scaling images outside of the darkroom

The diagonal line method and the proportional scale are used for scaling hard-copy images outside of the darkroom. Detailed explanations of both methods are found in DM Volume 4, chapter 1. If possible, you should mount the photograph to a solid backing, such as a piece of cardstock. An advantage in scaling artwork from prints is that as images are reduced, so are details. A disadvantage is that flaws are magnified in enlargements.

Marking enlargement or reduction on a print

Indicate the enlargement or reduction of images on the border around a print or on an overlay on the photograph. Enlargements and reductions may be indicated in percentages or in ratios.

Figure 7-23 illustrates examples of scaling percentages and ratios.

50% REDUCE
10% ENLARGE

A. PERCENTAGES

2:1 (REDUCTION)
1:2 (ENLARGEMENT)

B. RATIOS

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Figure 7-23.—Indicating scale: A. Percentages; B, Ratios.

Summary

Review

This chapter covers the operation and maintenance of process, copy, and small-format cameras. Lens descriptions are given to aid in the appropriate selection of lenses to maximize lens capabilities. Understanding lens speed and range gives you advantages that make your photographic experiences easier. Text on shutter speeds and apertures provides you with a fundamental understanding of how and why films record light as they do. Films and papers may be the end product or just a transitional step in a complicated creative process.

Comments

Photography is an integral part of graphic arts. The fundamentals of photography and the theory of light do not change, but technology surrounding the equipment and consumables changes regularly. Recent technological changes rapidly infiltrating the industry are chemical-free electronic and digital imagery. The impact of these changes in the graphic arts world is great. Stay abreast of changes.